Exam 2 Formula Sheet

$$E = \gamma mc^2 \ (\mathrm{m} \neq 0), \quad E = \frac{hc}{\lambda} \ \text{(photons)}, \quad E^2 = p^2c^2 + m^2c^4, \quad \gamma = \frac{1}{\sqrt{1-\frac{v^2}{c^2}}}$$

$$z = \frac{\Delta\lambda}{\lambda_0} = \sqrt{\frac{1+\frac{v}{c}}{1-\frac{v}{c}}} - 1$$

$$\text{For a neutral Hydrogen atom}: \ E_n = -\frac{13.6\mathrm{eV}}{n^2}, \quad g_n = 2n^2$$

$$\text{M.} - \text{B. distribution function}: \ n_v dv = n\left(\frac{m}{2\pi kT}\right)^{3/2} e^{-mv^2/2kT} 4\pi v^2 dv, \quad v_{rms} = \sqrt{\frac{3kT}{m}}$$

$$\text{Boltzmann Equation}: \ \frac{N_b}{N_a} = \frac{g_b}{g_a} e^{-(E_b - E_a)/kT}$$

$$\text{Saha Equation}: \ \frac{N_{i+1}}{N_i} = \frac{2kTZ_{i+1}}{P_e Z_i}\left(\frac{2\pi m_e kT}{h^2}\right)^{3/2} e^{-\chi/kT}, \quad Z = g_1 + \sum_{j=2}^{\infty} g_j e^{-(E_j - E_1)/kT}$$

$$F = \frac{L}{4\pi r^2}, \quad m_1 - m_2 = -2.5\log\left(\frac{F_1}{F_2}\right), \quad m - M = 5\log d - 5$$

$$\text{Equations of Stellar Structure}: \ \frac{\mathrm{dP}}{\mathrm{dr}} = -\frac{\mathrm{GM_r}\rho}{\mathrm{r}^2}, \quad \frac{\mathrm{dM_r}}{\mathrm{dr}} = 4\pi\mathrm{r}^2\rho$$

$$\text{Binding Energy for a nucleus } {}^{\mathrm{A}}_{\mathrm{Z}}\mathrm{X} \text{ is}: \quad \mathrm{Q} = [\mathrm{Zm_p} + \mathrm{Nm_n} - \mathrm{m}({}^{\mathrm{A}}_{\mathrm{Z}}\mathrm{X})]c^2$$

$$P_e \approx K\rho^{5/3}, \text{where}, \quad K = \left(\frac{3}{8\pi}\right)^{2/3} \frac{h^2}{5m_e}\left(\frac{Z}{A}\cdot\frac{1}{m_H}\right)^{5/3}.$$

$$\text{Interval for flat space} - \text{time (cartesian coordinates)}: \quad \mathrm{ds^2 = c^2dt^2 - dx^2 - dy^2 - dz^2}$$

$$\text{Interval for flat space} - \text{time (spherical coordinates)}: \quad \mathrm{ds^2 = c^2dt^2 - dr^2 - r^2d}\theta^2 - \mathrm{r^2}\sin^2\theta\mathrm{d}\phi^2$$

$$\text{Interval for Schwarzschild metric}: \quad \mathrm{ds^2 = c^2dt^2}\left(1 - \frac{\mathrm{2GM}}{\mathrm{rc^2}}\right) - \mathrm{dr^2}\left(1 - \frac{\mathrm{2GM}}{\mathrm{rc^2}}\right)^{-1} - \mathrm{r^2d}\theta^2 - \mathrm{r^2}\sin^2\theta\mathrm{d}\phi^2$$